Review article

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Morbidity among infants born in breech presentation

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1 Causes of breech presentation

Breech presentation and breech delivery are more hazardous for the fetus than cephalic ones. The failure of vertex positioning during the last 3 months of pregnancy may be due to a variety of disturbances such as uterine anomalies, contracted pelvis, cornual-fundal implantation of the placenta, abnormally short umbilical cord [54], oligohydramnios and pelvic tumors [19, 39, 51]. The higher incidence of breech presentation among preterm infants is caused by the lie of the fetus, which is not stabilized, until the beginning of the third trimester of pregnancy due to the relatively large volume of amniotic fluid. Correspondingly breech delivery is found more often in infants with polyhydramnios. In twin pregnancies at term, one infant often lies in cephalic, the other one in breech presentation. This combination can be assumed to be the best form of adaptation to the uterine cavity for twins. LAW (cited by [19]) showed that the legs of the fetus were extended in 74% of primiparous breech presentations, while the figure for multiparae was only 55%. The differences can be related to the affect which the unstretched abdominal and uterine walls may have on the uterine cavity in first pregnancies. For the same reason breech presentations occur more frequently with primiparae than with multiparae [14, 35]. In some cases fetal abnormalities favour breech presentation, for instance, in infants with spina bifida (paralyzed legs) or with malformations of the lower extremities. Congenital malformations have been found almost three times as often in breech deliveries [12, 31]. Neuromuscular dysfunction may limit the ability of the fetus to assume vertex position. In a brief communication entitled "Breech presentation as an indicator of fetal abnormality", BRAUN et al. [11] list eleven morphologic syndromes which are associated with an increased incidence of breech presentation. Most of these are rare, but some are relatively common: e.g. embryofetal-alcohol syndrome or 21-trisomie syndrome. Therefore, when a term infant is born by breech presentation, the reasons why the fetus failed to take the vertex position should always be sought because these reasons may include morphogenetic and/or functional disturbances of the fetus. The important point here is that a particular pathology need not be caused by breech delivery. And in such a case it might be unwarranted to give preference to abdominal delivery in an attempt to eliminate that risk of brain damage which is associated with vaginal birth [34].

Curriculum vitae

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2 Perils associated with breech delivery

The causes are well known. During the beginning of the labor the umbilical cord can prolapse and become compressed (2.5% in [53]; 5.4% in [12]). Even without prolapse the hazard of cord compression is increased because the abdomen and the cord enter the narrow confines of the birth canal earlier than they do in cephalic deliveries and are subject to abnormal pressures through the entire period when chest, shoulders, and head pass the pelvic inlet. The placenta may begin to separate when the uterus starts to empty. Complications of abruptio placentae are significantly more frequent with breech (6.0%) than with non-breech deliveries (1.8%) [12]. Both situations make it more probable that the breech infant will be born more deeply asphyxiated than the cephalic one.

The mechanical difficulties concern the delivery of the shoulders and the arms as well as the delivery of the aftercoming head. Among infants with brachial plexus palsy those born by breech presentation outnumber those born in cephalic presentation by 3 to 1 [16]. When the injury includes the phrenic nerve, paralysis of the diaphragma may produce respiratory disorders. Besides, respiration distress syndromes are mostly due to aspiration and meconium pneumonitis. In preterm infants prolonged asphyxia often is followed by the idiopathic respiratory distress syndrome (hyaline membrane disease) and/or by massive pulmonary haemorrhage. According to the literature [54] approximately 30% of the breech born infants are prematures. Nearly 20% of the stillbirths are delivered in breech presentation [53].

Cephalhematoma are equally frequent with breech born and vertex born infants. Approximately 25% of such cases have an underlying linear or depressed skull fracture [7, 32, 40]. Only rarely do they combine with subdural hematoma [1]. Clavicula fracture, hematoma in the midportion of the sternocleidomastoid muscle (torticollis), and dysplasia or dislocation of the hip-joint [3, 53] are considerably more frequent with breech born infants. FETTWEIS [23] found that congenital dislocation of the hip is about 9 times more frequent with infants with breech presentation than with head presentation. He could also show that this malformation involves only infants with extended legs. BARLOW [3] reports congenital hip displasia in 20% of all infants with breech presentations.

Testicular birth trauma was found in 10% of the male breech delivered infants. It is not yet possible to state whether, or how often sterility through a permanent damage of the testes may result [18]. RÁLIS [44] describes severely damaged testicles within the inguinal canal in two cases.

Traction on the hyperextended spine of the infant with the head fixed in the maternal pelvis may lead to a long opisthotonus position, which can often be noted with infants after breech delivery (own observations). Severe spinal cord injuries are rare and they usually cause death soon after birth [5]. Fractures of the humerus and injuries of the humeral epiphysis in freeing the arms have become rare. Breech extraction in footlings or breech presentation with version and extraction may cause characteristic meta-epiphyseal lesions and periosteal elevation in the lower extremities [37, 51]. These lesions take care of themselves unless they are associated with any separation or dislocation of the epiphysis. Prolonged abduction of the hip involves sustained traction of the obturator nerve between the points of fixation at the knee joint and the pubic ramus. Fortunately, the palsy of the adductor and the internal rotator muscles disappears within a few weeks after birth [15].

Although the aetiology of the hypopituitary dwarfism is uncertain, a number of authors [6, 45, 56] assume that perinatal lesions of the pituitary stalk may be a major factor. BIERICH [6] and VAN DER WERFF TEN BOSCH [56] state that nearly two thirds of their patients were born in breech presentation. It is easy to see how the hypophysis may get injured: the head of the breech delivered infant will be subjected to extremely strong variations of pressure. In particular, these pathomechanical forces lead to strains between the basis of the brain and the hypophysis.

Brain damage is the most common cause of death with breech born infants. Frequently, intracranial haemorrhage was found in post-mortem examinations, namely 50% [9], 48% [44], 35% [46]. These figures include both damage due to asphyxia and mechanical trauma. It seems, that in term infants there is a prevalence of mechanical factors. But, without doubt, prematurity may

also play an important role with preterm infants because the fragility of the vessels and the immaturity of the organs, including the brain itself, predisposes to bleeding.

RÁLÍS [44] in his study of the birth trauma to muscles in babies born by breech delivery emphasizes the fetal combination of extensive muscle damage, crush-syndrome, haemorrhagic shock, and disseminated intravascular coagulation.

Whether adrenal haemorrhage in breech born infants is due to trauma, anoxia, or severe stress, is unknown. X-rays showing calcified central haematoma of the adrenal in older infants suggest that not all adrenal haemorrhages lead to death [40] (own observation).

In summary, most injuries of the sceletal and of the peripheral nervous system restitute ad integrum. Damages to the internal organs and to the brain are fatal. In order to answer the question of how often latent brain injuries may occur and to what extent they may be reversible, follow-up studies examining the psychomotoric development of high risk infants should be of particular interest.

3 Critical remarks on the validity of follow-up studies in breech born infants

Quite a number of follow-up studies have already been done on breech born infants. However, only a few of them hold up to critical evaluation. It is not surprising therefore that the results of these studies vary considerably, for instance, some researchers [8, 25, 27, 30, 34, 43, 48] predict favorable developments for breech born infants, others [9, 21, 24, 42, 47, 50, 55] suggest unfavorable ones. Unfortunately, all of these follow-up studies have serious shortcomings. The most important are:

1. Most of these studies proceed retrospectively. Exceptions are BERENDES [4], NELIGAN [43], and our own work (see below), which continues the German prospective study "Schwangerschaftsverlauf und Kindesentwicklung". The main weakness of retrospective studies is that the researcher has to depend on records that are neither complete nor consistent. Worst of all, he has to depend on the memory of the parents, which increases the uncertainty [36]. Those follow-up studies which base their evaluation solely on questionnaires have produced, in general, more favorable results than those that also include neurological and psychometric examinations. Prospective investigations sufficiently broad in scope have the advantage of permitting the simultaneous study of many different complications as well as the interrelationship of each with other aetiological or associated factors [4].
2. The number of cases is too small and the area from which they are drawn is too restricted. Consequently, such results are not representative. But even the large follow-up studies do not provide enough cases for subdividing the children into those born in frank, in complete, or in incomplete breech presentation, in footling and in knee presentation. Such a subgrouping is all the more important since it is well known that the last two varieties correlate with a higher mortality rate than the first three named. No study is available in which the longterm prognosis for the vaginally breechborn infants is given separately according to the obstetrical type of delivery. Furthermore, there are as yet no reports about the advantages and disadvantages of the cephalic version which is again attracting a lot of attention.
3. Most follow-up studies do not bother to provide control groups. For instance, in studies on spastic children and on children with learning disability one tends to find a significantly higher proportion of breech delivered infants. If such variables as prematurity, twins, or anomalies of the placenta, are not taken into account separately, then the overall longterm predictions for breech born infants will be much more unfavorable. This, however, need not be associated exclusively with difficulties due to the mechanics of the delivery itself.
4. In general, the follow-up investigations are carried out only once and almost exclusively during infancy. As a rule, the methodology has been rather crude. However, minor disabilities may not become evident until the child reaches school age. On the other hand initial retardations may have been overcome before the child enters school. In order to detect more

Tab. I. Review of literature.

Authors	Studied infants born	Mortality rate	Sectio rate	Follow-up at age	Mental/neurol. Defects Breech	Controls	Comments
TALLIÁN et al. 1965	1947–54	3%	–	6–12y.	7.8%	4.5%	Physical examination (+EEG in case of need) of 176 breech delivered infants and 110 controls
BOLTE et al. 1968	1947–57	4.4%	5.8%	4–14y.	20%	10.1% (Sect. caes.)	Catamnestic review + EEG. Focal changes after breech delivery 6.2%, non-breech delivery (Sectio caes.) 3.7%
MULLER et al. 1971	1956	–	–	9y.	24.5%	8.3%	Questionnaires to teachers. Percentages refer to learning difficulties. Lorge-Thorndike intelligence test showed no significant differences
FIANU 1976	1956–69	2.8% (7.2%)	7.6%	5–16y.	5.7%	1.6%	1106 questionnaires answered by parents and teachers. Percentages refer to learning handicaps
BUTLER 1975	1958	– (21%)	–	7y.	2.8%	1.8% (Sect. caes.)	British National Child Development Study. Educational, medical, and social information.
SINDER & WENTSLER 1964	1958–62	1.7% (7.7%)	10.2%	0–5y.	2.7%	–	Questionnaires answered by parents. 260 infants of which 6 were mentally retarded, 1 cerebral palsy. 8 infants had cong. hip dislocation
SADOWSKI & STAEMMLER 1974	1958–66	–	–	6–14y.	–	–	Survey of several schools. Quota of breechborn within spastics 15.4%. Within collective of control pupils 4.6%. No significant quotas among the pupils with learning difficulties and with mental defects

NELIGAN 1976	1960–62	– (7.6%)	–	5 and 10y.	n.s.	n.s.	New Castle Survey of Child Development. No significant differences for the IQ-tests at 5y., no differences at 10y.
GÖBEL et al. 1971	1960–65	2.2%	11.2%	5–10y.	2.7%	0.75%	Evaluation of questionnaires: 3 cases of cerebral palsy among 110 breech delivered infants
ALEXOPOULOS 1973	1963–64	5.3%		2–2½y. and 8y.	7.2%	–	Follow-up only of the hypoxic breechborn infants. All infants with severe asphyxia were handicapped.
HOHLWEG-MAJERT & WILLARD 1975	1965–70	–	19.6%	3–7y.	n.s.	n.s.	Kramer intelligence test: mean IQ for 75 breechborn infants 109, controls 110
HOCHULI et al. 1977	1972–75	–	34.3%	1/2–4y.	7.5%	–	8 out of 106 children with minimal cerebral palsy. Same morbidity rate for infants born vaginally or by sectio. Malformation rate 5%.
HILL et al. 1976	1972–75	0.54% (1.6%)	31.7%	3y.	1.6%	–	Improvement of the mortality and morbidity rate by liberal use of caesarean section
MANZKE 1978	1965–71	1.75% (16.5%)	27.0%	up to 6y.	6.9%	3.5%	Prospective longterm follow-up study.

n.s. = not significant; (%) = corrected mortality rate (esp. without premature infants)

subtile differences standardized psychometric and neurological-motoscopic tests have to be applied. The application of such tests is easier and the results tend to be more reliable as a function of increasing age of the children. It seems that this is the only way to single out those children with minimal cerebral dysfunction. Surely, such children can be expected to be more numerous than those with clinically detectable abnormalities.

The advantage of prospective longterm investigations is to allow for more exact research planning. But, the disadvantage is that they trail ad hoc statistics by at least a few years. The results of shortterm changes relating to new obstetric methods can be investigated only much later.

4 General statements

Tab. I summarizes some findings of follow-up studies in infants born by breech delivery. The data are listed from 13 papers published since 1960. Even though the various studies are not strictly comparable for methodological reasons it seems nonetheless that the fetal morbidity rate and the mortality rate have decreased over the last 30 years. At the same time an increased caesarean section rate is evident. But it is not this technique itself, but more sophisticated indication that has produced better results. In particular, it is the early application of the caesarean section before or just at the beginning of the labor.

An analysis of the older literature reveals that cerebral palsy, epilepsy, and dyskinetic syndromes are more characteristic for residual cerebral damage in vaginally breech born infants than mental deficiency. Intelligence tests carried out in breech and non-breech delivered children showed no or only slight (statistically significant) differences between both groups [27, 42, 43]. This would suggest, that particulary those complications, which are prone to produce mechanical trauma, can be prevented by appropriate application of caesarean sections. It implies, too, that improvement of the perinatal care not only reduces the neonatal mortality rate but it also lowers the incidence of cerebral palsy as was shown by HAGBERG et al. [26]. A detailed review of the previous follow-up studies and the presentation of the results of our own investigations are intended to illustrate these general statements.

5 Follow-ups in the neonatal period

The three most common kinds of neonatal morbidity are asphyxia, respiratory distress syndrome, and birth injury. Some babies come under all three headings.

ALEXOPULOS [2] analysed 443 children born between 1963–64. 70 (16%) showed signs of neonatal morbidity, more precisely: 41 had asphyxia, 12 had paralysis of the brachial nerve, 3 had paralysis of the facial nerve, 6 had fractures of the long bones, and 1 had a dislocation of an elbow. 7 boys exhibited injuries to the external genitalia. Similar percentages are mentioned in a short communication by MORTON [41].

BIRD and MCELIN [7] using the ZATUCHNI-ANDROS Prognostic Scoring Index succeeded in reducing their fetal mortality (0.69%) and morbidity rates in term babies markedly since 1968. During that time the caesarean section rate increased from 6.1% to 19.3%. Since caesarean sections began to be applied earlier in the course of the women's labors, the rate of babies with cardio-respiratory depression at birth dropped from 16% before 1968 to 4% after.

HILL et al. [28] stress the use of fetal blood sampling as a reliable method of detecting early asphyxia. In their 1972–74 series of 186 cases of breech presentation (beyond 32 weeks gestation) only 1 infant died (mortality rate 0.6%) and only 3 infants (1.6%) appeared retarded when seen for pediatric follow-up at 3 years. The mortality rate was 4.5% in the same clinic in 1967. The improvement was achieved by increased application of caesarean section (31%).

EFTHIMIADIS [22] presents a critical review of 535 breech deliveries over 15 years and compares this to the present trend to deliver all primigravida breech presentations by caesarean section. The neonatal morbidity rate was 3.2%. Since 1969, when the sectio rate increased from 9.2% to 21.2%, the fetal morbidity was 0% for breech delivery. Apparently he did not take into account

asphyxia and respiratory distress syndrome as sometimes unavoidable complications also in caesarean section.

HOCHULI et al. [29] used routine X-ray pelvimetry in breech, ultrasound fetal cephalometry and thoracometry to determine whether a caesarean section was called for. They point out that under these circumstances there is no difference in the mortality and morbidity rates in infants with breech presentations born vaginally or by caesarean section. Their sectio rate was 34.3%. They note, furthermore, that the delivery of an infant in breech presentation can also be difficult and full of risks if done by caesarean section. Among 106 breech infants during the years 1972–75 8 infants (7.5%) were retarded or they showed signs of minimal cerebral palsy.

6 Follow-ups during infancy and preschool period

BERENDES [4] outlines the examination results of the children in the US Collaborative Perinatal Project. The findings are based on a comprehensive neurological examination at the age of 1 year. In children whose birth weight was less than 2.501 g the abnormality rate (10%) was twice that of the non-breech delivered children. Among those whose birth weight exceeded 2.500 g, however, there was no difference between the breech and non-breech groups as far as the proportions of abnormals (1.8%) were concerned.

HOHLWEG-MAJERT and WILLARD [30] likewise did not find any significant differences at the IQ-values between a group of 75 breech delivered and 71 non-breech delivered infants examined at the age of 3 to 7 years. The mean IQ was 109 and 110, respectively (KRAMER-Intelligence Test).

NELIGAN [43] attempted to assess the development of all children born to mothers in NewCastle upon Tyne during the years 1960–62. He found no excess of gross, but a doubtful excess of mild neurological abnormalities attributable to breech delivery. In both tests at the age of 5 years (Goodenough Draw-a-Man test and Figure Copying score, BINET) the scores for breech delivered boys were significantly depressed, whereas those of the girls were not at all depressed, as compared with those born spontaneously by vertex presentation. Furthermore, the depression of IQ was striking in the group of the heavier breech born infants which very likely may be the result of mechanical difficulties during delivery.

But the differences in the mean IQ-values within all groups compared with each other were slight. The analysis of variance revealed as significant contributory factors the number of previous pregnancies, the birth weight, and the occupational social class. Reassessment of the children at the age of 10 years by somewhat more sophisticated tests showed such slight differences between the breech and non-breech delivered children, that no statistical tests were carried out.

SINDER and WENTSLER [53] evaluated questionaires sent to the parents. Among 260 breech delivered infants 6 were mentally retarded, and 1 had cerebral palsy (morbidity rate 2.7%). 8 infants had congenital hip dislocations. 20.1% of the breech babies were premature.

SANO et al. [48] studied the relationship between the mental development quotient (DQ) and modes of delivery in one year old infants born in 1971–74. But they did not find any significant differences. The average value of DQ was 111.1 in 56 infants born by caesarean section, 109.7 in 67 infants born with vacuum extraction, 117.0 in 3 infants delivered with forceps operation and 110.4 in 48 infants delivered with breech extraction. Likewise within the group of infants with DQ under 90 there were no differences correlating with the various modes of delivery.

TALLIAN et al. [54] re-examined 176 breech born children with normal birth weight at ages 6–12 years. If needed an EEG was recorded. It was found that the incidence of mental deficiency and neurological abnormality was twice as high as in a control group of 110 children born spontaneously in vertex position.

7 Follow-ups in school period and after

In the catamnestical histories of 339 breech born infants reviewed at the age of 4–14 years BOLTE et al. [9] considered 20.0% of their subjects neurologically abnormal (for example, delay in somatic or psychic development, cerebral palsy, ataxia,

frequent headaches or seizures). The percentage of a positive neurological history in this respect was in infants with forceps delivery 12.4%, vacuum extraction 10.2% and caesarean section 10.1%. Electroencephalographic examination revealed focal changes in 6.2% of the breech delivered infants vs. 3.7% of the nonbreech infants born by caesarean section.

Some evidence about longterm prognosis is available from the British National Child Development Study [43]. This follow-up survey comprises all babies born between March 3–9, 1958, and who were survivors of the British Perinatal Mortality Survey carried out for 98% of all births registered throughout England, Scotland and Wales. The children were tested at 7 years of age. Among 330 breech born subjects less than a dozen (2.8%) had a severe handicap. A significantly higher proportion had signs of minimal cerebral dysfunction and poor educational ratings at school, which might be explained to some extent by the 20% incidence of low birth weight in breech delivery. There was no evidence of minimal cerebral dysfunction after delivery by caesarean section.

FIANU [24] analysed the questionaires sent to the parents and teachers of 1106 breech born children comparing these with the questionaires of the same number of children born in vertex presentation. He found significant differences between the two groups as follows: visual disturbances 12.6% vs. 5.6%, speech disorders 10.4% vs. 4.9%, intellectual and/or physical handicaps 2.5% vs. 0.5%, reading and writing difficulties 43.3% vs. 26.2%. Premature and term infants were not differentiated.

MULLER et al. [42] did a retrospective study involving 2383 infants and a 9 year follow-up of 1698. They state, that the breech born infants more commonly needed remedial measures, more frequently repeated grades, and more commonly had arithmetic achievement levels below normal than their controls. Those who repeated grades amounted to 15.2% in the group of infants with birth weight below 2.500 g, and 24.5% in the group of breech born infants. There was no significant difference of the LORGE-THORNDIKE Intelligence Test between the breech born infants and their controls. SADOWSKI and STAEMMLER [47], in a field study, investigated the quota of breech born infants among the pupils of elementary schools (4.6%) and among pupils from schools for backward children (5.5%). A significant increased rate of breech born children was found only for the group of the physically disabled pupils (15.4%).

Contrary to these above authors, TENHAEFF et al. [55] found a higher rate of breech born children among the pupils of schools for backward children (7.8% out of 477) compared to pupils of elementary schools and grammar schools (3.1% out of 476). The learning difficulties of the breechborns are traced to subletal birth injuries in 84% of the cases and to genetically determined disorders or to postnatal traumata in the remaining 16%.

HAMBERT and AKESSON [27] made a sociopsychiatric analysis of 192 breech born young men and 192 controls born during 1938–42. They found no conclusive evidence that up to the age of 25–30 years the breechborns were disposed extraordinary to sociopsychiatric disorders. Intelligence testing at the time of registration for military service showed that the breechborns and the controls did not differ significantly in their intellectual capacity.

8 Own results of follow-up examinations in 6 years old children born by breech delivery

58 breech born infants were checked at regular intervals from the neonatal period to the age of 6 years exactly. In order to investigate the extent to which neurological or mental abnormalities in breechborns might be due to the mode of delivery itself, the subjects were divided into those born by vaginal delivery (n = 43) and those born by sectio caesarea (n = 15). The first baby born in the same clinic by spontaneous cephalic delivery after each breech born subject was taken as the control. Furthermore, the breechborns were matched according to sex, birth weight, and socioeconomic background. The child's social class was established via his father's occupation [33].

Tab. II shows the incidence of some abnormal findings in the 58 breech born infants and their controls up to 3 years of age. For statistical calculations the two groups, i.e. the vaginally breech

Tab. II. Incidence of some abnormal findings in 58 breechborn infants and their controls up to 3 years of age.

age	abnormal findings	breechborn vag. n = 43	breechborn, Sectio n = 15	matched pairs n = 58	X^2-test p
6 weeks	Cannot raise head in prone position	3 (7%)	0	1 (1.7%)	n.s.
	Dysplasia of the hip	12 (28%)	4 (27%)	8 (14%)	$p < 0.1$
9 months	Cannot sit up alone	13 (30%)	7 (46%)	12 (21%)	$p < 0.1$
	Cannot pull to standing position	19 (44%)	8 (53%)	13 (22%)	$p < 0.01$
18 months	Cannot walk alone	1 (2.3%)	0	1 (1.7%)	n.s.
	Cannot name objects	15 (35%)	4 (27%)	21 (36%)	n.s.
36 months	Cannot use whole sentences	2 (4.6%)	1 (6.6%)	3 (5.2%)	n.s.
	Still wetting pants	21 (49%)	6 (40%)	22 (38%)	n.s.

n.s. = not significant

born infants and the infants delivered by caesarean section, were amalgamated into one and then compared with the matched pairs. It is interesting to note that among the abnormal findings (selected out of a list of 18 variables) only the nine month one, i.e. cannot pull to standing position, was found significantly more frequent with the breech born infants than with the controls. ($p < 0.01$). However, the chances are that the differences may be caused by the higher incidence of dysplasia of the hip ($p < 0.1$) rather than by retarded motoric development of the breech born infants. Most infants with dysplasia of the hip had to be treated with an abduction splint ("Spreizhose") until the 6th month. There were 6 children who, in every examination from the neonatal period until the age of three years, showed signs of retardation. Three of these were vaginally breech born infants, 1 was an infant delivered by caesarean section, and 2 were matched pairs.

At the age of 6 years all children were reexamined thoroughly by pediatricians, psychologists, ophthalmologists and otolaryngologists (audiometry). Only the neurological-psychological findings including the EEG-findings are reported here. There were no differences in the intergroup physical findings (height, weight, head circumference). The psychological examination consisted of the Columbia Mental Maturity Scale, the RAVEN Coloured Matrices Test and the Peabody Picture Vocabulary Test [10]. For assessment of the motoric functional status the HAMM-MARBURGER Body Coordination Test [49] was applied in a reduced from (3 instead of 4 exercises). Furthermore, the motor behavior of the children was rated on a neurologic-motoscopic scale which consisted of 22 items, such as hopping on one foot, skipping and finger-nose test; optimal scoring index 22. In contrast to the latter high ratings in the other tests indicate good performance. Tab. III presents the results of the neurological-motoscopic Score of the 58 breech born infants and their matched pairs. The mean values of the probands and their controls differ only slightly. However, using the Wilcoxon matched pairs signed ranks test, the differences of the intelligence tests as well as of the neurological-motoscopic tests, were significant between the vaginally breech born children and their controls, whereas the differences between the sectio delivered children and their controls did not show any significance.

It is noticeable that all mean values belong to the higher range of the age specific standard values. This is undoubtedly due to the fact that children from the upper social classes were overrepresented. Among the vaginally breech born children unfavorable results with a neurologic-motoscopic score > 27 points were significantly more frequent with boys than with girls. Furthermore, a lower Columbia Mental Maturity Scale (< 60 points) and a lower RAVEN Test Score (< 20 points) were found significantly more frequently with children of primiparae than of multiparae.

The correlation coefficient between both intelligence tests was $r = 0.53$, and the one between the Columbia Mental Maturity Scale and the Peabody Picture Vocabulary Test $r = 0.56$, whereas the intelligence tests did not correlate significantly with

Tab. III. Results of psychological and neurological-motoscopic examination of 58 breechborn children and their controls at the age of 6 years.

tests	breechborn vag. n = 43	matched pairs n = 43	breechborn sectio n = 15	matched pairs n = 15
Columbia Mental Maturity Scale	59.1 ± 11.4*	62.6 ± 8.5	66.6 ± 12.7	67.1 ± 11.6
RAVEN (Coloured Matrices) Test	17.7 ± 4.3*	19.7 ± 4.8	22.2 ± 6.8	23.2 ± 6.9
Peabody Picture Vocabulary Test	54.6 ± 5.8**	57.2 ± 5.7	60.1 ± 5.6	57.7 ± 5.4
HAMM-MARBURGER Body-Coordination Test	61.3 ± 22.9**	67.3 ± 23.8	60.5 ± 24.9	63.7 ± 26.1
Neurological-Motoscopic Score	25.4 ± 4.0*	24.0 ± 2.5	24.8 ± 3.3	26.2 ± 5.5

**Significance at 1% and * at 5% level (WILCOXON matched pairs test)

the Neurologic-Motoscopic Score and with the HAMM-MARBURGER Body Coordination Tests (r = 0.1–0.31).

The electroencephalograms obtained from 108 children showed no significant differences between the findings of the probands and their matched pairs (Tab. IV). None of the children had a clinically manifested epilepsy. The relatively high incidence of theta-rhythms is age-dependent. Between the age of 2 and 5 years this sign is physiological. In older children with unimpaired brains abnormal thetarhythms of the background activity are found in up to 15% [17].

In summary our research has been able to conclude that the prognosis for development of those children born through the vagina and who were in a pre-delivery position with the pelvis foremost, is on the whole marginally less favorable than that for children in the same position and who were delivered by caesarean section.

Tab. IV. Abnormal EEG-findings (n = 108).

	ϑ-and/or δ-rhythms	diffuse slowing	foci	foto-sensibility
breechborns (n = 54)	18 (33%)	1	4	2
matched pairs (n = 54)	14 (26%)	2	3	2

Keywords: Breech-delivered infants, follow-up studies, morbidity rate.

Zusammenfassung

Gesundheitliche Schäden bei in Beckenendlage geborenen Kindern

Die Ursachen der Beckenendlage sind sehr verschieden. Sie können in seltenen Fällen Begleitphänomen primär geschädigter Feten sein. Fehlbildungen werden bei Beckenendlage-Kindern zwei- bis dreimal [12, 31] häufiger als bei Schädellage-Kindern angetroffen, desgleichen bestimmte Dysmorphie-Syndrome [11] wie zum Beispiel das embryofetale Alkoholsyndrom oder die Trisomie-21. Daher sollte man bei der Untersuchung von Beckenendlage-Kindern besonders auf morphologische oder funktionelle Störungen achten.

Typische Gefahren der Beckenendlagengeburt sind Vorfall der Nabelschnur, Nabelschnurkompression, vorzeitige Lösung der Plazenta [12] sowie mechanische Verletzungen des Kindes: Plexuslähmung des Armes [16], Klavikulafraktur, Tortikollis, Hüftdysplasie und Genitalhämatome [18]. Eine angeborene Hüftgelenksluxation wird bei Beckenendlage-Kindern neunmal häufiger als bei Schädellage-Kindern gefunden: sie betrifft fast ausschließlich Feten, die in utero mit ausgestreckten Beinen liegen [23]. Als seltene Komplikationen seien genannt: Lähmung des N. obturator [15], Läsionen des Hypophysenstiels (hypophysärer Zwergwuchs [6, 56]) und ausgedehnte Muskelblutungen mit der Ausbildung eines Crush-Syndroms [44]. Atemstörungen können die Folge von Fruchtwasser- bzw. Mekonium-Aspiration, Zwerchfelllähmung, Lungenblutung oder eines idiopathischen Atemnotsyndroms sein. Fast 30% der Beckenendlage-Kinder sind Frühgeborene [54] [sowie

bisher unveröffentlichte Zahlen aus dem PU-Programm „Schwangerschaftsverlauf und Kindesentwicklung"]. Als häufigste Todesursache werden intrakranielle Blutungen angetroffen.

Die medizinische Literatur weist eine große Zahl Nachuntersuchungsstudien an Beckenendlage-Kindern auf, deren Aussagekraft jedoch aufgrund methodischer Mängel begrenzt ist (Kapitel 3). Ein Vergleichskollektiv fehlt häufig. Arbeiten, die sich nur auf die Auswertung von Fragebögen stützen, zeigen zumeist günstigere Ergebnisse als solche, die mit neurologischen und psychometrischen Testuntersuchungen kombiniert sind. In Studien an Kindern mit Lernstörungen oder mit körperlichen und geistigen Behinderungen lassen sich ursächlich verschiedene perinatale Einflußfaktoren wie Frühgeburt, Zwillingskind und postnatale Atemstörung retrospektiv gar nicht oder nur schwer voneinander trennen. Der Prozentsatz an Beckenendlage-Kindern ist in solchen Kollektiven unverhältnismäßig hoch (8–15% [47, 55]). Prospektive Studien [4, 38, 43] haben demgegenüber den Vorteil, daß sie von einem unausgewählten Patientengut ausgehen und sich statistisch einwandfrei bearbeiten lassen.

Allgemein läßt sich feststellen, daß mit Zunahme der Sektiofrequenz bzw. durch eine verfeinerte Indikationsstellung zur Schnittentbindung die Mortalitätsziffer und Morbiditätsrate der Beckenendlage-Kinder während der letzten 30 Jahre deutlich gesenkt werden konnten (s. Tab. I).

Vergleichende Intelligenztestungen an Beckenendlage-Kindern [27, 42, 43] lassen nur geringe, statistisch kaum signifikante Unterschiede erkennen. In den Kapiteln 5–7 werden die wichtigsten Daten der einzelnen Nachuntersuchungsstudien entsprechend dem Zeitpunkt der Erfassung: Neonatalperiode, Kleinkindes- sowie Schulalter, kurz referiert.

Eigene Nachuntersuchungsergebnisse (Kapitel 8) basieren auf einer Nachuntersuchung von 58 Beckenendlage-Kindern im Alter von 6 Jahren. Die Probanden gehören zur prospektiven Untersuchungsreihe „Schwangerschaftsverlauf und Kindesentwicklung" (DFG). Im Matched Pair-Verfahren wurde jedem Beckenendlage-Kind das in derselben prospektiven Untersuchungsreihe nächstfolgende Kind gegenübergestellt, welches spontan aus Schädellage geboren war, gleiches Geschlecht und gleiches Gewicht aufwies sowie aus gleichen sozioökonomischen Verhältnissen stammte. Weiterhin wurden die Beckenendlage-Kinder aufgeteilt in solche, die vaginal (n = 43) und solche, die durch Sektio geboren waren (n = 15). Bei der grob orientierenden Analyse der Entwicklungsdaten bis zum Alter von 3 Jahren fiel lediglich eine größere Zahl von Beckenendlage-Kindern auf (44% bzw. 53% gegenüber 22% bei den Kontrollkindern), die im Alter von 9 Monaten noch nicht ihre Beine zum Stehen aufstellen konnten ($p < 0{,}01$, s. Tab. II). Dieser Befund steht sicher mit der größeren Anzahl von Hüftdysplasien unter den Beckenendlage-Kindern und deren Behandlung mit einer Spreizhose in Zusammenhang (28%: 14%; $p < 0{,}1$). Insgesamt zeigten 6 Kinder, von denen 3 vaginal aus Beckenendlage, 1 durch Sektio aus Beckenendlage und 2 aus Schädellage geboren waren, eine verzögerte Entwicklung.

Darüberhinaus ließen sich erst bei der Analyse der psychometrischen und neurologisch-motoskopischen Testergebnisse im Alter von 6 Jahren signifikante Leistungsunterschiede zwischen den vaginal aus Beckenendlage geborenen Kindern und deren Matched pairs feststellen, während zwischen den durch Sektio geborenen Beckenendlage-Kindern und deren Matched pairs keine Differenzen nachweisbar waren (s. Tab. III). Die quantitativ nur geringen Unterschiede sind sowohl bei den 3 angewandten Intelligenztests Columbia Mental Maturity Scale, RAVEN-Test und Peabody Picture Vocabulary Test als auch beim HAMM-MARBURGER-Körperkoordinationstest und bei dem von uns selbst zusammengestellten neurologisch-motoskopischen Summationsscore auffällig. Bezogen auf die Altersnormwerte [10, 49] liegen jedoch auch die Mittelwerte der vaginal aus Beckenendlage geborenen Kinder in unserem Nachuntersuchungskollektiv im oberen Normbereich. Grund hierfür mag sein, daß ein überrepräsentativ großer Anteil unserer Probanden aus sozial höheren Schichten stammt.

Unter den vaginal geborenen Beckenendlage-Kindern fanden sich signifikant schlechtere Testergebnisse im neurologisch-motoskopischen Summationsscore bei den Knaben als bei den Mädchen, sowie signifikant schlechtere Leistungen in der Columbia Mental Maturity Scale und im Raven-Test bei den Kindern von Primipara als von Multipara.

Die EEG-Befunde (s. Tab. IV) ergaben keine gruppensignifikanten Unterschiede.

Zusammenfassend lassen unsere Nachuntersuchungsergebnisse den Schluß zu, daß **im allgemeinen die Entwicklungsprognose der vaginal aus Beckenendlage geborenen Kinder geringgradig schlechter ist als die der durch Sectio caesarea aus Beckenendlage geborenen Kinder.**

Schlüsselwörter: Beckenendlage-Kinder, Nachuntersuchungsstudien, Spätmorbidität.

Résumé

La morbidité chez les bébés nés avec position du siège

Les causes de la position du siège sont très différentes. Elles peuvent dans de rares cas être des symptômes secondaires de foetus aux lésions primaires. Les malformations sont de deux à trois fois [12, 31] plus fréquentes chez les enfants avec position du siège qu'avec position du sommet, de même en est-il pour certains syndromes de dysmorphie [11] tels que le syndrome d'alcool embryofoetal ou la trisomie 21. Aussi devrait-on insister davantage sur l'examen des troubles morphologiques ou fonctionnels chez les enfants avec position du siège.

Les dangers-types des accouchements par position du siège sont le prolapsus ou la compression du cordon ombilical, le détachement prématuré du placenta [12] ainsi que les blessures mécaniques de l'enfant: paralysie d'un plexus du bras [16], fracture de la clavicule, torticolis, dysplasie de la hanche et hématomes génitaux [18]. Une luxation coxale congénitale est neuf fois plus fréquente chez les

enfants avec position du siège qu'avec position du sommet: elle concerne presqu'exclusivement les foetus qui reposent les jambes étendues dans l'utérus [23]. Des complications plus rares peuvent apparaître comme la paralysie du N. Obturator [15], des lésions de la tige pituitaire (6, 56) et des myohémorragies avec développement d'un syndrome de broiement des membres [44]. Des troubles respiratoires peuvent également résulter d'une aspiration amniotique ou de méconium, d'une phrénoplégie, de pneumorragie ou d'un syndrome de dyspnée protopathique. Près de 30% des enfants avec position du siège sont prématurés ([54], et d'après les chiffres non encore publiés du programme PU de «Grossesse et Développement embryonnaire»). Les hémorragies intracrâniennes semblent constituer la cause de mort la plus fréquente.

La littérature médicale contient un grand nombre d'études de réexamen d'enfants avec position du siège, mais leurs méthodes défectueuses les rendent encore insuffisamment probantes (ch. 3). Elles manquent souvent d'analyses comparatives avec un groupe de sujets normaux. Les travaux qui reposent seulement sur l'évaluation de questionnaires montrent des résultats en général plus favorables que ceux qui sont combinés avec des tests neurologiques et psychométriques. Dans les observations d'enfants souffrant de difficultés d'apprentissage ou d'handicaps physiques et psychiques, il est malaisé ou même impossible de différencier rétrospectivement les diverses causes périnatales telles que l'accouchement prématuré ou gémellaire, le trouble de la respiration postnatal. Le pourcentage des enfants avec position du siège est élevé dans de tels groupes (8–15% [47, 55]). Des études prospectives [4, 38, 43] ont, à cet égard, l'avantage de partir de sujets pris au hasard et de fournir ainsi des statistiques absolument sûres.

D'une façon générale, on peut constater une baisse certaine des taux de mortalité et de morbidité des enfants avec position du siège au cours des 30 dernières années grâce à l'augmentation des césariennes et à la plus grande différenciation de leur indication (cf. Tab. I). Des tests d'intelligence comparatifs effectués sur des enfants nés avec position du siège [27, 42, 43] ne permettent d'obtenir que des différences minimales, d'un intérêt pratiquement nul pour les statistiques. Les ch. 5 et 7 commentent brièvement les principaux résultats des études suivant les divers moments où ont été effectués les réexamens: périodes néonatale, de la petite enfance et scolaire.

Les propres résultats de réexamen (ch. 8) se basent sur les observations à l'âge de 6 ans de 58 enfants nés avec position du siège. Les propositions relèvent de la série d'examens prospectifs «Grossesse et Développement embryonnaire» (DFG). Selon un processus de Matched Pair, chaque enfant avec position du siège a été confronté avec un enfant né spontanément avec position du sommet, de même sexe, de même poids et de même statut social. De plus, les enfants avec position du siège ont été répartis en deux groupes, l'un d'accouchement vaginal (n = 43), l'autre de césarienne (n « 15). L'analyse sommaire des résultats de développement jusqu'à l'âge de 3 ans s'est montrée seulement intéressante par le nombre supérieur des enfants avec position du siège (44% et 53% contre 22% chez les enfants du groupe de contrôle) qui, à l'âge de 9 mois, ne parvenaient pas encore à placer leurs jambes pour se mettre dans la station debout ($p < 0{,}01$, cf' Tab. II). Ce résultat dépend sans aucun doute du nombre également supérieur de dysplasies coxales parmi les enfants avec position du siège et de leur traitement par pantalon d'écartement (28%: 14%; $p < 0{,}1$).

6 enfants au total, dont 3 avec accouchement vaginal de position du siège, 1 avec césarienne de position du siège et 2 avec position du sommet, ont fait état d'un développement retardé.

Par ailleurs, seule l'analyse des tests psychométriques et neurologiques-motoscopiques à l'âge de 6 ans a permis de constater des différences de performance significatives entre les enfants avec position du siège nés par accouchement vaginal et leurs matched pairs, tandis qu'aucune différence n'a pu être relevée entre les enfants avec position du siège nés par césarienne et leurs matched pairs (cf. Tab. III). Les différences faibles du point de vue quantitatif ont pu être établies aussi bien par les 3 tests d'intelligence Columbia Mental Maturity Scale, RAVEN-Test et Peabody Picture Vocabulary Test que par le test de coordination physique de HAMM-MARBURG et par le Summationscore neurologique-motoscopique que nous avons élaboré nousmêmes. Comparées aux normes d'âge [10, 49], les moyennes des enfants nés en position du siège par accouchement vaginal et appartenant à notre groupe de réexamen se situent, toutefois, dans la zone supérieure des normes, ce qui est peut-être dû à ce que la majorité de nos propositions proviennent de couches sociales élevées.

Parmi les enfants nés en position du siège par accouchement vaginal, le summationscore neurologique-motoscopique a donné des résultats nettement plus mauvais chez les garçons que chez les filles et le Columbia Mental Maturity Scale et le RAVEN-Test ont témoigné de performances sensiblement moins bonnes chez les enfants de primipares que de pluripares.

Les résultats d'EEG (cf. Tab. IV) n'ont révélé aucune différence significative entre les divers groupes.

En résumé, les données de nos réexamens permettent de conclure que, d'une façon générale, le pronostic de développement des enfants nès en position du siège par accouchement vaginal est un peu plus mauvais que chez les enfants nés en position du siège par césarienne.

Mots-clés: Enfants avec position du siège, études de réexamen, morbidité tardive

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